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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Preparing Activity: KSC

NASA/KSC-27 11 00.00 98 (October 2007)

Superseding
NASA/KSC-27 11 00.00 98 (February 2007)

NASA/KSC GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009
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DIVISION 27 - COMMUNICATIONS

SECTION 27 11 00.00 98

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

10/07

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SECTION 27 11 00.00 98

COMMUNICATIONS EQUIPMENT ROOM FITTINGS
10/07

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NOTE: This specification covers the requirements for Communication/Equipment Room and Entrance Facilities.Accordingly, tailor this section carefully to suit project conditions and to meet project requirements.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.
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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text are automatically deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60603-7	(1996) Connectors for Frequencies Below 3 MHz For Use With Printed Boardspart 7: Detail Specification for Connectors, 8-Way, Including Fixed and Free Connectors With Common Mating Features, With Assessed Quality

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA/EIA-568-B.1	(2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
TIA/EIA-606-A	(2002) Administration Standard for the Telecommunications Infrastructure

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 497	(2001; Rev thru Jun 2004) Protectors for Paired Conductor Communication Circuits

1.2 GENERAL REQUIREMENTS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTALS and edit the following list to reflect only the submittals required for the project. Keep submittals to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

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1.2.1 Scope

This section includes the minimum requirements for entrance equipment, termination hardware, and cable installations in main communication equipment rooms and communication rooms/closets.

Equip said spaces to contain the following:

Entrance Facility (EF) Terminals

Surge Protection Modules

Wall Mounted Distribution Frames

Ladder Racking/Cable Tray

Grounding and Bonding Provisions

Backboards

Frame Mounted Termination Blocks and Rings

Cross Connects

1.2.2 Quality Assurance

All spaces must be built-out in a neat and workmanlike manner.

Equipment and materials must be of the quality indicated.

Separation from sources of EMI must be as specified.

Communication grounding/earthing and bonding must be in accordance with applicable Codes and regulations. Grounding must meet the requirements of [_____], and be observed throughout the entire cabling system.

1.2.3 Environmental Requirements

Connecting hardware must be rated for operation under ambient conditions of 0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, non condensing.

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Keep submittals to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, use a code of up to three characters within the submittal tags following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office

(Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that must review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Floor Plans
Front Elevations

SD-03 Product Data

Provide manufacturer's catalog data for the following items:

Entrance Facility Terminals
Surge Protection Modules
Distribution Frames
Floor Mounted Equipment Racks
Floor Mounted Equipment Racks and Cabinets
Wall Mounted Equipment Cabinets
Wall Mounted Equipment Racks
Cable Management Hardware
Patch Panels
Fiber Optic Panels
Grounding Bars
110 System Blocks
Patch Cords
UTP Cross Connects
Backboards
Cable Tray

SD-11 Closeout Submittals

Floor Plans
Front Elevations
CAD Generated Drawings
Hard Copies

1.3.1 Preliminary Drawings

Prior to the start of work, submit preliminary drawings of the following: (Obtain electronic files of the building floor plans from the Contracting Officer)

Scaled 1:50 1/4" - 1'-0" Communication Room floor plans showing the planned location of all installed components.

Front elevations of a typical patch panel for each system.

1.3.2 As-Built Drawings

At the completion of the project, submit final record "As-Built" drawings of the following:

Scaled 1:50 1/4" - 1'-0" Communication Room floor plans showing all installed components.

Front elevations of all systems patch panels.

CAD generated drawings on size "F" sheets. Submit reproducible hard copies and electronic copies in ".DXF" or ".DWG" format.

PART 2 PRODUCTS

2.1 ENTRANCE FACILITIES

2.1.1 Entrance Facility Terminals

Entrance facility terminal must protect all lines (pairs), and input stub (tip) cable must be [26][Sized by NASA] AWG shielded cable. Field verify actual stub length in field. Input stub must serve as internal fuse link and must be equipped with a heavy-duty strain relief and encapsulated cable connector. Output stub cable must be 24 AWG shielded cable. Field verify actual stub length in field. Entrance facility terminals must be wall or frame mountable, accommodate industry standard 5 pin protection modules (R399A form factor), and the plastic components must meet or exceed requirements of UL 497.

2.1.2 Surge Protection Modules

Surge protection modules must be 5 pin, 3 element gas type protection modules and must provide true balanced operation. Over voltage on either side must cause the entire tube to ionize to provide a simultaneous path to ground for both sides of the circuit. Surge protection modules must be UL 497 listed. Ground pin must be tin, tip and ring pins must be gold alloy, and the module color must be black. Surge protection modules color must be green for spare pair modules. The nominal DC breakdown must be 350V @ 100V/usec. The impulse breakdown voltage must be 700A @ 100V/usec and 150A @1KV/usec.

The surge protection modules DC holding current must be 135V for <150ms. The surge protection modules surge life (min. operations) must be as follows:

@10A, 10 x 1000usec

The capacitance must be <1pf for 1 Vrms @ 1Khz, 50 DCV. The insulation resistance must be >100M ohms @ 50 VDC. The fail safe operation must be as follows:

@1.0A	<50 sec
@5.0A	<15 sec
@20A	<10 sec
@60A	<3 sec

The current limiters must be as follows:

hold current (ma) @ 20 C = 145
R min / max ohms = 3/6

2.1.3 Floor Mounted Frames for Protection Terminals

Provide 2.1m 84" high frames suitable for single side mounting of protection terminals, the overall width of frame must be 0.9m 35.5" and depth must be 381mm 15", and the frame must be supplied with 305mm 12" cable runway support, junctioning bolts, aluminum bond bars, grounding screws and screws for installing the blocks. Floor mounted frames for protection terminals must have 153mm 6" vertical channel to feed cables to blocks and the lowest installed block must be 153mm 6" A.F.F.

2.1.4 Floor Mounted Distribution Frames

Provide 2.1m 84" high frames suitable for single side mounting of 110 termination blocks. The frame must be configured to support the number of pairs indicated on the drawings, the overall width of frame must be 953m 37.5" and depth must be 409mm 16.13". Frame must be supplied with 305mm 12" cable runway support,junctioning bolts, bond bars, grounding screws and screws for installing the blocks. The frame must be divided into two modules. The top module must support six (6) 110 blocks and the bottom module must support nine (9) 110 blocks, with the lowest installed block being 457mm 18" A.F.F. Rack must have 153mm 6" vertical channel to feed cables to blocks.

2.1.5 Steel Ladder Racking/Cable Tray

Provide ladder rack/cable tray in equipment room, as shown on drawings for backbone cable support. Include connecting and support hardware to suit installation, including but not limited to, racks, runway mount plates, wall angle support brackets, butt splice swivels, connect junctions and grounding kit.

2.1.6 Grounding and Bonding

Provide grounding bar assembly as shown on drawings, and a minimum No. 2 grounding electrode conductor from ground bar to suitable electrical building ground. Label grounding and bonding hardware and connections per TIA/EIA-606-A. Grounding wire must be appropriately bonded to the grounding bar and electrical building ground. Ground bar assembly to be constructed with following materials (See drawing details for additional information):

a. Copper ground bar 6mm x 102mm x 305mm 1/4" x 4" x 12" with 7mm 9/32" holes spaced 32mm 1-1/8" apart.

b. Stand-off insulators.

c. Lockwashers.

d. Wall mounting brackets.

2.1.7 Backboards

Backboards must be 1.2m x 2.4m x 19mm 4' x 8' x 3/4" ACX or CX, fire rated plywood, or as indicated on the drawings. Backboards must be painted

gray, acrylic, interior, fire, retardant paint.

Install open end distribution rings for wall mounted cross-connect fields above all wall mounted blocks. Two ring per vertical row.

2.1.8 Termination Blocks on Frame

Blocks must be 110 style 300 pair blocks. Provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables.

2.1.9 UTP Cross Connects

Cross connect wire must be of same gauge (22 AWG and 24 AWG) as the feed cable to which it is being connected to. Typically, cross connect wire is 24 AWG single twisted pair and dual twisted pair wire as required for circuit being connected. Conductors must be rated a minimum of Category 5E. Cross connect wire colors must be:

a. White-Blue for voice circuits.

b. White-Red for fire alarm.

c. White-Black for temporary circuits.

d. Solid colored White-Blue-Red-Green for 4 wire services.

2.2 COMMUNICATIONS/EQUIPMENT ROOMS

2.2.1 Floor Mounted Equipment Racks

Racks must meet the following physical specifications:

a. 483 mm 19" rack mounting space.

b. 2.1 m 7'-0" tall.

c. Lightweight, high strength aluminum construction.

d. Black powder coat finish.

e. 381 mm 15" deep base with four (4) 19 mm 3/4" bolt down holes.

f. EIA Channel width of 76 mm 3.0", with No. 12-24 screw holes.

Rack must have double sided 12/24 tapped holes and EIA universal rack 16 mm to 16 mm - 13 mm 5/8" to 5/8"-1/2" standard hole pattern (compatible with32 mm - 13 mm 11/4" - 1/2" hole patterns).

2.2.2 Wall Mounted Equipment Racks

Wall mounted equipment racks must meet the following physical specifications:

a. 483 mm 19" rack mounting space.

b. 1.2 m 48" high with 24 mounting spaces.

c. Lightweight, high strength steel construction.

d. Black powder coat finish.

e. Stationary mounting with 533 mm 21" deep, 14 gauge mounting brackets and 45 kg 100 lb. capacity.

f. Racks must have double sides EIA universal rack 16 mm to 16 mm-13 mm 5/8" to 5/8"-1/2" standard hole pattern, (compatible with32 mm - 13 mm 11/4" - 1/2" hole patterns).

2.2.3 Wall Mounted Equipment Cabinets

Wall mounted equipment cabinets must meet the following specifications:

a. 483 mm 19" equipment mounting space.

b. 1.2 m 48" high with 26 rack mount spaces.

c. Universal mounting rails with 10/32 and 12/24 tapped holes.

d. 16 mm to 16 mm-13 mm 5/8" to 5/8"-1/2" EIA standard hole pattern.

e. Black powder coat finish.

Cabinets must have a two hinge design for front and rear access, louvered sides for ventilation, knockouts in top and bottom for cable access. Both front and rear access must be lockable.

2.2.4 Floor Mounted Cabinet

Floor mounted cabinets must meet the following specifications:

a. 16 gauge steel construction.

b. Nominal 1956 mm x 483 mm x 762 mm 77" x 19" x 30".

c. Lockable plexiglass hinged door on front and steel hinged door in rear.

d. Vented roof.

e. Removable side panels.

f. Leveling feet.

2.2.5 Cable Management for Equipment Racks

Cable management must be black metal with integral wire retaining fingers. Vertical cable management panels must have front and rear channels. Vertical cable management panels must have removable front and back covers, made of black metal. A horizontal crossover cable manager must be provided at the top of each relay rack, with a minimum height of 2 rack units each. A horizontal crossover cable manager must be provided near the center and at the bottom of each relay rack, with a minimum height of 4 rack units.

2.2.6 Patch Panels - Category 5E

The termination panels must support the appropriate Category 5E applications and facilitate cross-connection and inter-connection using

modular patch cords. Patch panels must be sized to fit an EIA standard 483 mm 19 inch rack, or be capable of mounting to a wall. Patch panels must accommodate at least 48 ports for each rack mount space, and have circuit boards tested in both directions as required by TIA/EIA-568-B.1. Patch panels must have angle left/angle right modules to provide optimum cable management, and must have removable six port modules to allow replacement in the field. Patch panels must have Category 5E jacks available in both T568A and T568B wiring schemes, with 110-style termination.

Patch panels must allow for a minimum of 200 re-terminations without signal degradation below standards compliance limit, and have modular ports compliant with FCC Part 68, subpart F and IEC 60603-7 with gold plating over nickel contacts or equivalent. They must allow the use of a 4-pair 110-style impact termination tool. Patch panels must have a plastic strip for physical protection of printed circuit board, have port identification numbers on both the front and rear of the panel, and provide clear label holders and white designation labels with the panel, with optional color labels available. Patch panels must be TIA/EIA-568-B.1 proposed Category 5E compliant.

The following performance requirements must be met (NEXT Loss and FEXT tested in both Differential and Common Mode):

PARAMETERS	PERFORMANCE @ 100 MHz
NEXT Loss	43.0 dB
FEXT	35.1 dB
Insertion Loss (Attenuation)	.4 dB
Return Loss	20 dB

Must be UL verified for TIA/EIA Category 5E electrical performance, must be made of a steel frame with black powder coat finish, 48 and 96 port configurations. Must allow the modular insert to accept 110-style patch plugs as a means of termination, must be T-568-B wired, provide 48 port panels, unless otherwise noted. Must be paired punch down sequence to allow pair twist within 13 mm 1/2" of the termination. Provide port configurations and densities as called for on drawings, provide rear cable management bar(s) as recommended by the manufacturer, and must be insulation displacement connector 110-style terminations. Provide TIA/EIA-606-A compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice or data functionality as required.

2.2.7 Fiber Optic Panels - Wall Mount Box

All panels and trays (units) must provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers. Wall mount boxes must be available in 12,24 port termination densities for a single door applications, must be available in 12, 24 and 48 port termination densities for dual door applications, accommodate various Simplex connectors including ST, SC, FC, LX.5, and MT-RJ, and have single or dual hinged doors. Wall mount boxes must have the ability to mount the cable clamp on the interior of the panel, feature adapters which are angled, and have radiused outer edges and be putty white in color. Wall mount boxes must offer factory termination of the optical cable as an option, and provide port configurations and densities as called for on drawings.

2.2.8 Fiber Optic Panels - Rack Mount (Low Fiber Count)

All panels and trays (units) must provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers. Rack mount panels must be available in 12 and 24 port with no splicing, be available in 24 port configuration for splicing, and allow mounting in either 483 mm 19 inch or 584 mm 23 inch equipment bays. Rack mount panels must allow flush or 127 mm 5 inch recess mounting, use adapter plates that house a minimum of six (6) adapters each, and have adapters angled to the left and right of the panel. Rack mount panels must be available in black or putty. They must meet or exceed all TSB-72 requirements, provide port configurations and densities as called for on drawings, and must be wall or rack mountable. Rack mount panels must have a hinged removable front cover and feature a front access design with a hinged bulkhead plate.

2.2.9 Fiber Optic Panels/Frames - Rack Mount (Moderate Fiber Count)

All panels and trays (units) must provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers. They must be available in 12, 24, 48, 72, and 96 port configurations, feature a front access design with hinged bulkhead plate, and use adapter plates that house six (6) adapters each. They must have a hinged removable front cover, adapters that are angled to the left of the panel, have an integrated vertical cableway on one side of the panel, and be mountable in flush, 25 mm, 50 mm, and 127 mm1", 2", and 5" recess options, and must be wall mountable. They must be 483 mm 19 inch and 584 mm 23 inch rack mountable, have storage and splicing options as part of the product offering, and be available in black or putty.

2.2.10 Fiber Optic Frames - Rack Mount (High Fiber Count)

All panels and trays (units) must provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers. They must be available in putty or black, and made of 12-gauge aluminum alloy. They must be available in up to 24, 32, 48, and 72 port versions with ST or MT-RJ fiber adapters pre-loaded into adapter plates, or 48, 64, 96, and 144 port versions using quad SC fiber adapters pre-loaded into adapter plates. They must have pre-loaded adapter plates with SC, ST, or MT-RJ fiber adapters in 6 and 8 port versions, as well as a 12 port version for the SC adapter and have blank adapter plates for future growth of the fiber infrastructure.

Frames must have fiber managers to effectively store fiber cable slack and comply with fiber bend radius requirements, have six and eight port fiber adapter plates, which allow for color coding connectors, and accommodate stackable splice trays, each tray manages a minimum total of 24 splices. They must have an adapter plate-mounting bracket, which slides out to the front and to the rear of the unit for increased access, have capable access points for fiber jumpers entering and exiting the unit, with rotating grommets to facilitate cable loading and to minimize micro bending stress, and have anchor points for fiber cable(s) entering the unit. They must have labeling which meets or exceeds TIA/EIA-606-A requirements and also be laser printable.

All frames must be mountable both 483 mm 19 inch and 584 mm 23 inch rack/cabinets. Provide port configurations and densities as called for on the drawings.

2.2.11 Fiber Optic Trays - Rack Mount

All panels and trays (units) must provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers. The rack mount trays must be made of 18-gauge steel with a black finish, be available in 16-, 24-, 28-, 32-, and 48-port configurations, and be able to double that port count utilizing 6-port adapters. They must accommodate SC, ST, and MT-RJ adapters, accommodate hybrid adapter bezels for ST-to-SC or SC-to-ST, or MT-RJ to MT-RJ connections, and have changeable ports, which are removed from the front of the unit to allow custom configuration or modification.

The rack mount trays must have silk screened port identification numbers provided on both the front and rear of the panel, include fiber managers that manage slack storage so as to comply with fiber bend radius requirements and slack storage length recommendations, accommodate stackable splice trays, which manage up to 24 splices per tray, and have a smoked polycarbonate cover with quarter turn screws for easy access. The rack mounted trays must not exceed a 254 mm 10 in depth for mounting in standard cabinets and enclosures, must be provided with strain relief lugs for the fiber cable entering the unit from the side or back, and provide port configurations and densities as called for on drawings.

2.2.12 Backboards

Backboards must be 1.2 m x 2.4 m x 19 mm 4 x 8 x 3/4" ACX, exterior grade, fire rated plywood, and must be painted - gray, acrylic, interior, fire retardant paint. Backboards must provide adequate support and dress horizontal cabling between ladder rack and 110 wiring blocks as necessary or as shown on the drawings. Review cable routing plan for the Telecommunications Rooms, in the field, before installation of cabling commences.

2.2.13 110 System Blocks

The connecting hardware block must support the appropriate Category 3 or Category 5E applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords. System blocks must be 110 System IDC style blocks, UL verified or equivalent for TIA/EIA Category electrical performance, and TIA/EIA-568-B.1 Category 3 or Category 5E compliant.

The following criteria must be met (NEXT Loss and FEXT tested in both Differential and Common Mode):

PARAMETERS	PERFORMANCE @ 100 MHz
NEXT Loss	43.0 dB
FEXT	35.1 dB
Insertion Loss (Attenuation)	.4 dB
Return Loss	20 dB

The system blocks must be made of flame retardant thermoplastic, be available in 50-, 100-, and 300-pair sizes, and have 50-, 100-, and 300-pair blocks available without legs, while the 100, and 300 pair blocks are available with legs. Blocks must include means to identify cables/services per TIA/EIA-606-A, must have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert

labels provided with the product must contain vertical lines spaces on the basis of circuit size (3-, 4-, or 5-pair) and must not interfere with running, tracing or removing jumper wire/patch cords. Label holders must be capable of mounting in the under portion of the wiring block. System blocks must have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. The connecting blocks must be available in 3-, 4-, and 5-pair sizes.

All connecting blocks must have color-coded tip and ring designation markers and be of single piece construction. System blocks must have connecting blocks with a minimum of 200 re-termination without signal degradation below standard compliance limit. They must support wire sizes: Solid 22-26 AWG (0.64 mm - 0.40 mm), and 7-strand wires. They must be made by an ISO 9001 Certified Manufacturer and must be 300 pair blocks, typical for feed and station cable, unless otherwise noted. Provide keep-off indicator buttons on all active cross-connected pairs used for alarm and security purposes. Coordinate the color and use with the Contracting Officer. Provide connecting block designation label strips of the colors conforming to TIA/EIA-606-A.

2.2.14 Cross Connect

Provide modular 110 cross connect blocks for all backbone terminations. Make cross connects with wire of equal gauge and performance category to that of the feed cable, which it is being connected to. Cross connect must be UL listed, and provide one (1) roll of 1-pair and one (1) roll of 2-pair per Telecommunications Room (TR). Coordinate color code of one and two pair with Contracting Officer.

2.2.15 Grounding Bars

Provide grounding bar assembly as shown on drawings and a minimum No. 4 grounding electrode conductor from ground bar to suitable electrical building ground. Label grounding and bonding hardware and connections per TIA/EIA-606-A. Grounding wire must be appropriately bonded to the grounding bar and electrical building ground rod. The ground bar assembly must be constructed with the following materials (see drawing details for additional information):

a. Copper ground bar 1/4" x 4" x 10" with 9/32" holes spaced 1-1/8" apart.

b. Stand-off insulators.

c. Lockwashers.

d. Wall mounting brackets.

2.2.16 Optical Fiber Patch Cords - Multimode

Optical fiber patch cords must be available in standard lengths of 1, 3, and 5 meters, custom lengths must also be available, and must meet or exceed standards as defined in TIA/EIA-568-B.1. They must utilize duplex optical fiber cable that is 62.5/125 or 50/125 micron multimode, OFNR riser grade, must utilize optical fiber cable where the attenuation must not exceed 3.5 dB/km @ 850 nm wave length or 1.0 dB/km @ 1300 nm, and must be equipped with SC, ST, or MT-RJ connectors. Patch cords must have terminated connectors exhibit a maximum insertion loss of 0.75 dB with an average of 0.40 dB when tested at either 850 nm or 1300 nm wave lengths for

62.5/125 um, and have terminated connectors exhibit a maximum insertion loss of 0.75 dB with an average of 0.50 dB when tested at either 850 nm or 1300 nm wave lengths for 50/125 um. Optical fiber patch cords must have a minimum return loss of 20 dB (25 dB typical) at both 850 nm and 1300 nm. They must be a duplex fiber cable meeting or exceeding the transmission characteristics of the optical fiber horizontal cable. Provide configuration of patch cords as required to accommodate the application.

2.2.17 Category 5E Patch Cords

Category 5E patch cords must be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame retardant jacket, and must be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring. Use modular plugs and have gold plating over nickel contacts. Category 5E patch cords must be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants, utilize cable that exhibits power sum NEXT performance, and must be available in several colors with or without color strain relief boots providing snagless design.

Category 5E patch cords must meet the flex test requirements of 1000 cycles with boots and 100 cycles without boots, be available in any custom length and standard lengths of meters (3, 5, 7, 10, 15, 20, and 25 feet), and input impedance without averaging must be 100 ohms plus or minus 15 percent from 1 to 100 MHz. Category 5E patch cords must utilize cable that is UL verified (or equivalent) for TIA/EIA proposed Category 5E electrical performance.

PART 3 EXECUTION

3.1 ENTRANCE FACILITY TERMINALS

Terminals must be frame mounted. Field verify actual length required for the input and output stubs. If the scope of work does not include splicing of the tip cable to the feed cable, provide clear labeling at the splice end of the tip cable referencing rack, row, and block information. Coordinate with Owner. Terminate output stub to appropriate block on distribution frame. Coordinate with Owner. Install No. 4 grounding conductor as straight as possible from terminal to ground bar.

3.2 SURGE PROTECTION MODULES

Fully protect all pairs entering a building, either with active pair surge protection modules or surge protection modules specified of inactive pairs. Provide cost allowance in base bid for 80 percent active modules and 20 percent shunt modules.

3.3 FLOOR MOUNTED DISTRIBUTION FRAMES

Install frames as per drawings, in accordance with manufacturer instructions. Frames must be securely fastened to the floor using expansion anchors, and must be plumb and square with the room.

3.4 STEEL LADDER RACKING/CABLE TRAY

Install all ladder rack/cable tray and associated mounting hardware in a manner that allows it to support its maximum rated load. Locate ladder rack/cable tray a minimum of 457 mm above top of floor mounted rack or wall mounted cross-connect fields. Installation must comply with manufacturer's

instructions.

3.5 TERMINATION BLOCKS ON FRAME

Install color designation strips as follows:

DESCRIPTION	COLOR
C.O. Circuits	Orange
Common Equipment - PBX, Lan's, Muxes	Purple
First Level Backbone Cable	White
Second Level Backbone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits - Alarm, Security	Yellow
Future use and Key Systems	Red
Inter-building Campus Backbone	Brown

Install red insulator clips on all special circuits in the Main Equipment Room termination hardware and cross-connect facilities (ER). Confirm with the Contracting Officer which circuits to designatr as special.

3.6 FLOOR MOUNTED EQUIPMENT RACKS AND CABINETS

All floor mounted equipment racks must be anchored to the floor and be plumb, provide vertical and horizontal cable and terminations as shown on the drawing, and mount with a minimum of 1 m 36 inches clear access behind and front of rack from the wall to a rack. Floor mounted equipment racks must ground the rack to the equipment ground bar. Adjacent racks can be bonded together. Communication grounding/earthing and bonding must be in accordance with applicable Codes and regulations. Install floor mounted equipment cabinets in a location which allows both the front and rear door to open a full 90 degrees. Install cabinets employing cooling fans such that there is at least 152 mm 6" of clear space above the top of the fan casing.

3.7 WALL MOUNTED EQUIPMENT RACKS AND CABINETS

Secure wall mounted equipment racks to building structure with approved anchoring means, verify all existing wall construction and submit proposed anchoring methods for approval, and provide vertical and horizontal cable management both front and rear wherever available. Install wall mounted equipment cabinets in such a way as to not interfere with the use of the front door or hinged body section.

3.8 CABLE MANAGEMENT

Provide a horizontal crossover cable manager at the top and bottom of each rack, with a minimum height of 2 rack units each. Provide a horizontal crossover cable manager near the center of each relay rack, with a minimum height of 4 rack units. Provide two rear cable management bars and reusable velcro-type hook and loop straps in each rear vertical channel. Provide reusable straps of varying sizes (each allowing 50 percent spare future expansion) and of adequate quantity to secure cable bundles at least every 4 rack units. Secure cable managers, slack managers, support bars, hook and loop straps per manufacturer recommendations.

3.8.1 Cable Supports

Provide "D" rings on 0.6m center for all exposed, wall mounted vertical

Category 5E cable runs. All horizontal cable runs within room must be on cable tray.

3.9 CATEGORY 5E PATCH PANELS

Install and label Category 5E patch panels as recommended by manufacturer, per all TIA/EIA-606-A. Install rear cable management bar(s) as recommended by manufacturer, and Install TIA/EIA-606-A compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice or data functionality.

Install panels to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination to the patch panel must be no greater than 13 mm 0.5 inches.

Install panels according to manufacturer's instructions and properly mounted to a rack, cabinet, bracket, or other appropriate mounting device.

Install panels such that cables terminated to the panel can maintain minimum bend radius of at least 4 times the cable diameter into the IDC contacts. Terminate cables on the panels such that there is no tension on the conductors in the termination contacts.

Properly label panels on front and back with the cable number and port connections for each port.

3.10 OPTICAL FIBER PATCH PANELS

Install panels according to manufacturer's instructions. Furnish and install labels for each strand, and install blank adapter panels in all positions not used at time of installation for fiber terminations.

Adhesive or snap-in routing clips must be secured to the inside of the adapter tray in such a fashion as to allow the maintenance of the minimum bend radius of the cable and the proper storage of at least 2 m of fiber cable inside the tray.

Properly anchor incoming cable as it enters the rear or bottom of the tray. Attack anchor to the cable jacket without excessive force and without crushing the cable jacket.

3.11 BACKBOARDS

Linear wall space used for anchoring equipment must be lined for the full room width with plywood, per the drawings. Plywood for mounting termination equipment must be installed vertically, side by each, a minimum of 152 mm 6 inches above finished floor. Mounting must be sufficient enough to support the equipment. Plywood for supporting backbone riser cables must be installed vertically, resting directly on the finished floor. Anchoring and mounting techniques of plywood used to support backbone riser cables must be sufficient to support a minimum of 453 kg 1000 pounds of weight. The heads of mounting screws must in no case protrude past the face of any plywood. Install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

3.12 110 SYSTEM BLOCKS

Install 110 system blocks on plywood backboard so that top of 300 pair block is 1.7 m 5'-6" above finished floor, or as noted on the drawing. Mount blocks with steel, zinc plated 8 mm 5/16 inch slotted hex head No. 10 x 19 mm 3/4 inch drill screws, minimum four screws per block. Install designation strips color-coded in conformance with TIA/EIA-606-A standard, generally as follows:

DESCRIPTION	COLOR
C.O. Circuits	Orange
Common Equipment - PBX, :LAN's, Muxes	Purple
First Level Backbone Cable	White
Second Level Backbone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits - Alarms, Security	Yellow
Future Use and Key Systems	Red
Inter-building Campus Backbone	Brown

3.13 GROUNDING AND BONDING

Install a copper ground bar in each communication equipment room, as per the plans, and bond all metallic equipment racks, conduits, cable tray, ladder racks, etc. to the ground bar, using No. 6 AWG (minimum) equipment grounding conductor. All connectors and clamps must be mechanical type made of silicon bronze, and terminals must be solderless compression type, copper long-barrel NEMA two bolt. Bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturer's recommended practices. Communication grounding/earthing and bonding must be in accordance with applicable codes and regulations.

3.14 MISCELLANEOUS REQUIREMENTS

Neatly dress, rack, label,and terminate all cables in communication rooms. Provide a minimum of 609 mm 24 inches service loop on each terminated conductor, unless otherwise specified.

Room support services including HVAC, lighting, power, and fire protection must be as indicated on the drawings.

Firestop all sleeves and conduit openings after the cable installation is complete.

-- End of Section --